PROJECT facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Advanced Turbine and Engine Systems

06/2000

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROJECTS TO REDUCE NO_x EMISSIONS IN GAS TURBINES

PRIMARY PARTNERS

Precision Combustion, Inc.
New Haven, CT

TDA Research, Inc.
Wheat Ridge, CO

Thermocore, Inc.
Lancaster, PA

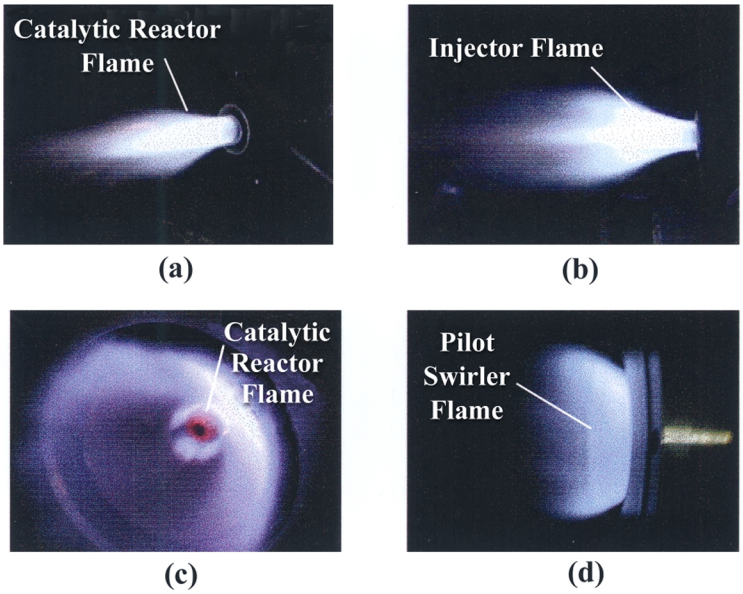
TOTAL ESTIMATED COST

$300,000

Description

Three small businesses have been awarded grants to develop innovative methods of reducing nitrogen oxide (NO_x) emissions in gas turbine power generators to regulated or lower levels.

Precision Combustion, Inc. (PCI) is developing a catalytic pilot burner technology that offers a relatively inexpensive method of lowering NO_x emissions to below 9 ppm. A catalytically stabilized, lean, premixed, fuel/air pilot burner replaces the standard diffusion flame pilot burner. All the functions of the pilot burner are performed, achieving low NO_x emissions through lean premixed operation. Lean stability is achieved through the catalytic reaction of a portion of the fuel mixture. In Phase I, PCI will complete computational fluid dynamics and stress analyses, fabricate prototypes of the optimum reactor, and perform an atmospheric pressure combustion test to determine how successful the pilot burner is in increasing the turndown capacity and lowering emissions to meet the emission goals of <10 ppm NO_x and <10 ppm carbon monoxide (CO). PCI has submitted a Phase 2 proposal.



Precision Combustion, Inc.: Catalytic Pilot Operation.
The catalytic pilot flame provides stability to the swirler flame.

Small Business Innovation Research (SBIR) Projects to Reduce NO_x Emissions in Gas Turbines

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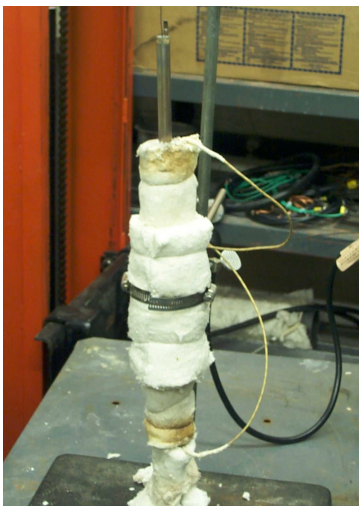

Thermocore, Inc.: Heat Pipe Preheater Test Setup

TDA Research, Inc.: High Throughput Reactor; used to test catalysts for gas turbine engines

TDA Research, Inc. is developing a fundamentally different route to produce high-surface-area hexaaluminate carbonates, which are compounds that could be suitable catalysts in catalytic combustion but that are difficult to synthesize. The use of a catalyst to control NO_x will allow power generators to meet NO_x emission standards without installing costly post-combustion treatment. TDA can prepare many compounds with well-controlled stoichiometries for testing with their method. TDA has also constructed and successfully tested a high-throughput catalyst testing apparatus that can test up to 12 samples per run. In Phase I, TDA will synthesize and test many combinations of bimetallic hexaluminates for methane oxidation activity. Experimental results will be used to guide subsequent catalyst components, and the most active catalyst will be tested to measure thermal stability. TDA has submitted a Phase 2 proposal.

Thermacore, Inc. is developing a heat pipe preheater, a passive heat transfer device that is integrated into a catalytic combustor to extract heat from combustion exhaust and dissipated heat to achieve preheating. This can quickly respond to changes in combustor conditions and is self adjusting to combustion and preheating zone temperatures. The passive fast response eliminates the need for expensive active control schemes and thus improves the marketability of low NO_x catalytic combustion technology. In Phase I, Thermacore will design, fabricate, and test a proportionally scaled at 1:11, proof-of-concept heat pipe preheater to verify the feasibility of the technology. This preheater segment will be capable of transporting 20 kilowatts of heat and sustaining a maximum temperature of1,430 °C. Thermacore will also begin developing theoretical models that can simulate catalytic combustion using the heat pipe preheater under various steady state and transient conditions. Thermacore has submitted a phase 2 proposal.

Duration

Start Date	09/04/1999
End Date	03/04/2000 (Phase 1)

Goal

The goal of these three projects is to reduce NO_x emissions in gas turbine engines while increasing efficiency and lowering costs.

Benefits

Successful results from these SBIR research projects will make possible the simultaneous achievement of higher efficiency and ultra-low NO_x emissions in gas turbine engine systems. The new methods could result in significant capital and operational cost savings, and could also lead to a substantial retrofit market. A major benefit is enhancing U.S. competitiveness in the highly competitive gas turbine market.